# CALIBRATION STANDARD REQUIREMENT

# FOR A

# PORTABLE TACHOMETER TESTER

* * * * * * * *

PROCUREMENT PACKAGE

Prepared by: Naval Warfare Assessment Division
Measurement Science Directorate
Code MS-33
Corona, CA 91718-5000

October 1995
Encl (1)

1. SCOPE

1.1 Scope. This requirement defines the mechanical and electrical performance requirements for a Portable Tachometer Tester. This equipment is intended for use by Navy personnel in shipboard and shorebased laboratories for the calibration of hand held tachometers, remotely driven tachometers and tachometer generators. For the purposes of this requirement, the Portable Tachometer Tester shall be referred to as the PTT.

2. APPLICABLE DOCUMENTS

2.1 Controlling Specifications. Mil-T-28800, “Military Specification, Test Equipment for use with Electrical and Electronic Equipment, General Specification for,” and all documents referenced therein of the issues in effect on the date of this solicitation shall form a part of this requirement.

3. REQUIREMENTS

3.1 General. The PTT shall conform to the Type II, Class 5, Style E requirements as specified in MIL-T-28800 for Navy shipboard and shorebased use as modified below. The use of material restricted for Navy use shall be governed by MIL-T-28800.

3.1.1 Design and Construction. The PTT design and construction shall meet the requirements of MIL-T-28800 for Type II equipment.

3.1.2 Power Requirements. The PTT shall operate from a source of 103.5 V to 126.5 V at 50 Hz and 60 Hz ± 5% single-phase as specified in MIL-T-28800.

3.1.2.1 Fuses or Circuit Breakers. Fuses or circuit breakers shall be provided. If circuit breakers are used, both sides of the power source shall be automatically disconnected from the equipment in the event of excessive current. If fuses are used, only the line side of the input power line shall be fused. Fuses or circuit breakers shall be readily accessible.

3.1.2.2 Power Connection. The requirements for power source connections shall be in accordance with MIL-T-28800 with a 6-foot (1.8 m) minimum length cord.

3.1.3 Dimensions and Weight. Maximum dimensions shall not exceed the following: 9 inches (23 cm) width, 14.5 inches (37 cm) in height and 16 inches (41 cm) in depth. The weight of the PTT shall not exceed 45 pounds (21 Kg).

3.1.4 Lithium Batteries. Per MIL-T-28800, lithium batteries are prohibited without prior authorization. A request or approval for the use of lithium batteries, including those encapsulated in integrated circuits, shall be submitted to the procuring activity at the time of submission of proposals. Approval shall apply only to the specific model proposed.

3.2 Environmental Requirements. The PTT shall meet the environmental requirements for a Type II, Class 5, Style E equipment with the deviations specified below.

3.2.1 Temperature and Humidity. The PTT shall meet the conditions below:

| | Temperature (°C) | Relative Humidity (%) |
|---|---|---|
| Operating | 10 to 30 | 95 |
| | 30 to 40 | 75 |
| Non-operating | -20 to 70 | Not Controlled |

3.2.2 Electromagnetic Compatibility. The electromagnetic compatibility requirements of MIL-T-28800 are limited to the following areas: CE01, CE03, CS01, CS02, CS06, RE01, RE02 (14 kHz to 1 Ghz), and RS03.

3.3 Reliability. The PTT shall meet the Type II reliability as specified in MIL-T-28800.

3.3.1 Calibration Interval. The PTT shall have an 85% or greater probability of remaining within tolerances of all requirements at the end of a 12 month period.

3.4 Maintainability. The PTT shall meet the Type II maintainability requirements as specified in MIL-T-28800 except the lowest discrete component shall be defined as a replaceable assembly. Certification time shall not exceed 60 minutes.

3.5 Performance Requirements. The PTT shall provide the capabilities listed below. Unless otherwise indicated, all performance requirement shall be met following a 15 minute warm-up period.

3.5.1 Configuration. The PTT shall consist of a drive motor assembly, including a drive motor, power take-off pad and associated parts, a digital frequency counter, a photoelectric pick off unit, a speed increaser, a speed reducer and other specified accessories.

3.5.2 Drive Motor Assembly. The assembly shall be dynamically balanced. Vibration shall not exceed 5 G’s peak nor 0.03 inch double amplitude in any plane at any speed.

3.5.3 Drive Motor.

3.5.3.1 Range. The drive motor shall be reversible, infinitely variable from 200 to 5000 rpm and variable in a minimum of 14 discrete steps from 250 to 5000 rpm. The range shall be extendible to 50 to 40000 rpm by use of specified speed increasers and speed reducers.

3.5.3.2 Driving Torque. The drive motor shall provide a constant, minimum torque output of 40 oz-in throughout its range.

3.5.4 Power Take-Off Pad. The power take-off pad shall be capable of driving SAE shaft driven tachometers, speed increasers of hand-held tachometers by means of an adapter. The power take-off pad shall be mounted on the control panel of the tachometer tester, and shall be connected to the motor drive shaft by a flexible coupling or other suitable means.

3.5.5 Stability. The drive motor speed shall be stable to ± 0.02% (maximum) of indicated reading at any set point, regardless of fluctuating load or supply line voltages (within specified limits).

3.5.6 Accuracy. The uncertainty of the indicated speed shall be ± 0.02% (maximum) at any speed setting.

3.5.7 Fixed Speed Settings. The fixed speed settings (switch selectable) listed below shall be provided and identified on the front panel. Front panel markings shall indicate motor speed in rpm and corresponding tachometer indicator graduation in percent at each setting.

| SPEED SETTING | MOTOR SPEED (RPM) | PERCENT SETTING |
|---|---|---|
| l | 250 | 5 |
| 2 | 320 | 6.4 |
| 3 | 400 | 8 |
| 4 | 500 | 10 |
| 5 | 640 | 12.8 |
| 6 | 800 | 16 |
| 7 | 1000 | 20 |
| 8 | 1250 | 25 |
| 9 | 1600 | 32 |

| | | |
|---|---|---|
| 10 | 2000 | 40 |
| 11 | 2500 | 50 |
| 12 | 3200 | 64 |
| 13 | 4000 | 80 |
| 14 | 5000 | 100 |

3.5.8 Response Time. The PTT shall display the rpm to rated accuracy with 1 second or less after speed selection.

3.5.9 Variable Setting. Variable setting (switch selectable) shall be provided on the front panel to obtain any simulated speed between 200 and 5000 rpm.

3.5.10 RPM Indicator. The rpm indicator shall consist of a six digit digital frequency/rpm counter readout, mounted on the control panel.

3.5.11 Frequency Counter. The frequency counter shall conform to the following requirements:

3.5.11.1 Frequency Range. The frequency range shall be a minimum of 10 Hz to 1 MHz.

3.5.11.2 Input Sensitivity. Sine wave: 150 mV RMS (maximum); square wave: 280 mV p-p (maximum). A sensitivity control shall be provided to adjust the input sensitivity from 280 mV p-p to 10 V p-p (sine wave).

3.5.11.3 Input Impedance. 1 megohm shunted by 30 pF.

3.5.11.4 Frequency Measurement Accuracy. Time base accuracy, ± 1 count.

3.5.11.5 Time Base.

3.5.11.5.1 Internal Frequency. 1 MHz crystal.

3.5.11.5.2 Temperature Effects. The effect of temperature shall be less than ± 0.1 ppm/°C from 10°C to 40°C.

3.5.11.5.3 Line Voltage Effects. The effect of changes in line voltage shall be ± 0.1 ppm maximum for ± 10% line voltage change from 115 VAC.

3.5.11.5.4 Time Base Accuracy. The time base accuracy shall be ± 1 ppm at 25°C and ± 10 ppm at 10°C to 40°C or better.

3.5.11.5.5 Time Base Selection. Time base selectable at 1 sec, 10 sec and 60 sec by use of push-button switches located on the control panel.

3.5.11.6 Pick-Off Power Supply. Shall contain internal 28 VDC, 40 mA power supply for photoelectric pick-off unit.

3.5.11.7 Display. Shall consist of a six digit in-line horizontal LED display, with provision for continuous display (memory).

3.5.11.8 Operational Modes. The counter shall provide the following model of operation.

3.5.11.8.1 Internal Mode. Shall automatically provide direct readout of PTT speed output in rpm units.

3.5.11.8.2 External Mode. Shall provide direct rpm reading when the PTT is used with the photoelectric pick-off unit.

3.5.11.8.3 Speed Increaser Mode. Shall provide direct rpm readings when the PTT is used with X8 or X2 speed increasers.

3.5.11.8.4 Test/Reset. Shall enable check of counter operation with an external 100 kHz signal and resetting the digital display.

3.5.12 Photoelectric Pick-Off Unit.

3.5.12.1 General. The photoelectric pick-off unit, when used in conjunction with the PTT counter, shall provide for direct rpm readings of external rotating objects. The pick-off unit shall consist of a 28 V light source, high sensitivity optical system and a photosensor. A linkage system shall permit the pick-off head to be locked in position and detect motion at a distance of 1.5 inch or less.

3.5.12.2 Power Requirements. The pick-off unit shall operate from 28 VDC, 40 mA power source provided by the counter.

3.6 Operating Requirements. The PTT shall provide the following functional and operating capabilities.

3.6.1 Control Panel. All operating controls and visual displays shall be mounted on a control panel, shall be readily accessible, logically arranged for convenient operation and legibly labeled.

3.6.2 Connectors. The following connectors shall be provided on the control panel:

a. BNC connector for connection of tachometer signal generator output signal to an external frequency counter.

b. BNC connector for application of external reference frequency standard to drive or calibrate the PTT remotely.

c. Phone jack for connection of photoelectric pick-off unit.

3.6.3 Calibration Adjustment Devices. Devices used only for calibration and adjustment shall be mounted on the control panel but shall be under a removable cover labeled “Remove for Calibration Only”.

3.7 Accessories. The following accessories shall be provided with each PTT.

3.7.1 Adapters. The following adapters shall be provided.

3.7.1.1 A detachable cone-type adapter with one end machined to fit the motor drive shaft, the other end 1/2 inch in diameter with a 1/2 inch-82° countersink for driving hand-held tachometers. The adapter design shall be adequate to prevent rotational slippage between its countersunk end and either the medium speed or high speed rubber tip of the tachometer drive shaft.

3.7.1.2 Cone-type adapters for connection to the speed increaser and speed reducer. Adapter design shall be equivalent to that specified in paragraph 3.7.1.1, except that the diameter of the speed increaser shall be 3/8 inch versus 1/2 inch.

3.7.2 BNC Cable. A four foot BNC cable shall be provided to connect the tachometer tester signal generator to an external electronic frequency counter.

3.7.3 Speed Increaser. A detachable multi-ratio single unit speed increaser with 1:2 and 1:8 speed increasing ratios shall be provided. The speed increaser shall mount on the power take-off pad and when used in conjunction with the PTT conform to the speed and stability conditions of this requirement.

3.7.4 Speed Reducer. A detachable speed reducer with a 4:1 speed reduction ration shall be provided. The speed reducer shall mount on the power take-off pad and when used in conjunction with the PTT shall conform to the speed and stability requirements of this requirement.

3.7.5 Flexible Drive-Shafts and Adapters. Four foot flexible drive shafts with appropriate fittings and snap-in, interchangeable drive tips shall be provided for in place testing

of a variety of tachometers and tachometer generators. One end of each drive shaft shall attach to the PTT power take-off pad; the other end shall contain 7/8-18 UNS-2 (SAE) (male and female) and 13/16-20 NS (Reliance) (male and female) threaded fittings. Each fitting shall accept snap in drive tips of the following types and dimensions (output end) and shall interface with the corresponding SAE, square, or Reliance Tachometer drives:

| TYPE | DIMENSIONS (INCHES) |
|---|---|
| SAE AEO MALE | .155/.150 O.D. ROD |
| SAE AERO FEMALE | .163/.159 I.D. RECEPTACLE |
| SAE MARINE MALE | .188/.183 O.D. ROD |
| SAE MARINE FEMALE | .193/.189 I.D. RECEPTACLE |
| SAE MARINE HEAVY MALE | .206/.200 O.D. ROD |
| SAE MARINE HEAVY FEMALE | .214/.210 I.D. RECEPTACLE |
| SQUARE MALE | .104/.101 SQ. |
| SQUARE FEMALE | .108/.105 SQ. |
| SQUARE MALE | .124/.120 SQ. |
| SQUARE FEMALE | .128/.124 SQ. |
| SQUARE MALE | .150/.147 SQ. |
| SQUARE FEMALE | .154/.150 SQ. |
| SQUARE MALE | .245/.243 SQ. |
| SQUARE FEMALE | .249/.246 SQ. |
| RELIANCE FLAT TIP (MALE) | .048/.046 |
| RELIANCE FLAT TIP (FEMALE) | .065/.060 |

3.7.5.1 The drive tips specified above shall be solid, one piece construction for maximum strength and durability.

3.7.5.2 In addition to the above, a reducing nut adapter, 7/8 inch to 5/8 inch thread shall be provided.

3.8 Manual. At least two copies of an operation and maintenance manual shall be provided. The manual shall meet the requirements of MIL-M-7298.

3.8.1 Calibration Procedure. The manual shall include a calibration procedure in accordance with MIL-M-38793.